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| 10/526,918  | 11/14/2005  | Richard P. Anderson  | ITP 34              | 7530             |
| 43098   | 7590        | 12/27/2007           |                     |                  |
| HARRY M. LEVY<br>OLSON & HIERL, LTD.<br>20 North Wacker<br>36th Floor<br>CHICAGO, IL 60606-4401 |             |                      |                     |                  |
| EXAMINER  |             |                      |                     |                  |
| SHEVIN, MARK L  |             |                      |                     |                  |
| ART UNIT  |             | PAPER NUMBER         |                     |                  |
| 4116  |             |                      |                     |                  |
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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/526,918

**Applicant(s)**

ANDERSON ET AL.

**Examiner**

Mark L. Shevin

**Art Unit**

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 7 March 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-25 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 7 March 2005 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-8508)
- Paper No(s)/Mail Date 17 January 2006
- 4) ☐ Interview Summary (PTO-413)
- Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Inventor's Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Status***

1. Claims 1-25, filed 7 March 2005, are pending.

### ***Specification***

2. This application does not contain an abstract of the disclosure as required by 37 CFR 1.72(b). An abstract on a separate sheet is required. The abstract of Applicant's PCT publication WO 2004/022800 should be cut from the cover page and resubmitted on a separate page to comply. The specification is objected to until appropriate correction.

### ***Priority***

3. Claim to domestic benefit of provisional applications 60/408,932; 60/408,925; and 60/408,933, all filed 7 September 2002, is noted.

### ***Claim Rejections - 35 USC § 103***

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. **Claims 1-25** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Armstrong** (US 5,958,106) in view of **Keller** (US 2,846,303).

Armstrong is directed to a continuous method of producing a non-metal element or a metal or an alloy thereof, particularly titanium (Abstract and Fig. 1). Armstrong reviews the history of titanium metal production stating that "the reduction of titanium tetrachloride to metal has been attempted using a number of reducing agents including hydrogen, carbon, sodium, calcium, aluminum, and magnesium" (Col. 1, lines 33-36). One object of the invention is to operate the reaction and separation processes to avoid sintering the titanium product into large masses (Col. 2, lines 43-47). A second object of the invention is to recycle the reducing agent (Col. 2, lines 48-54).

#### *Process Flexibility*

The metal production method of Armstrong may be practiced with any alkali or alkaline earth metal and any combination of halides to reduce a variety of metals or non-metals (Col. 3, lines 16-28, see also Table 1). It is possible to make alloys of a predetermined composition by varying the ratio of halides introduced as reactants (Col. 3, lines 29-34). Lithium, potassium, as well as calcium and other alkaline earth metals are available and thermodynamically feasible to be used as reagents and alloys products can be produced by providing a suitable halide feed in the molecular ratio of the desired alloy (Col. 7, lines 40-56).

#### *Separation*

The desired titanium metal solids are separated from the liquid metal reactants and salts in element **15** (Fig. 1) which may be a conventional separator including a

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particulate filter after being carried in by a stream of sodium (Col. 4, lines 18-23). In one method taught for the separation of the titanium product, residual sodium and sodium chloride would be washed from the titanium product using a water-alcohol wash. Filtration is used to remove products from the bulk sodium. A filter **26** was connected to the outlet of the reaction vessel and used to separate titanium product. The reaction product titanium was washed with ethyl alcohol to remove sodium and water to remove residual sodium chloride (Col. 7, lines 16-30). Claims 12 and 37 disclose separating Ti powder from liquid Na.

Again sintering is to be avoided in separation of the titanium product and this is obtained by control of the titanium product's temperature using sufficient molten sodium metal or diluent gas (Col. 5, lines 19-30).

Armstrong does not explicitly teach the process steps of claim 1 in decanting the liquid metal.

Keller teaches a method of producing metals by reducing a metal halide, forming titanium metal in particular (Col. 1, lines 15-22). The reaction crystals are so adjusted that the product titanium consists of large crystals of titanium which can be removed from the reactor as a slurry of crystalline titanium in the molten salt (Col. 2, lines 12-16).

Keller teaches (Col. 3, line 75 to Col. 4, line 9) that:

...the resultant slurry of titanium crystals, molten salt, and excess sodium is then subjected to a separation step **14** which may be a simple decanting operation wherein the excess sodium is removed, as a liquid, from the mixture. Most of the excess by-product salt may also be drained off at this point, and a relatively concentrated mixture of titanium crystals and salt may then be transferred to an aqueous acid leaching bath, indicated at **16**. It is obvious that the titanium crystals must be cooled prior to the aqueous acid leaching step.

This separation process is reflected in Fig. 1 as steps 14 and 16.

Regarding claims 1, 3, 4, and 5.

It would have been obvious to one of ordinary skill in the metallurgical arts at the time the invention was made, taking the teachings of Armstrong and Keller as a whole, to combine Armstrong in view of Keller to carry out the process of claim 1 in decanting the excess liquid metal and then reintroducing it into the concentrated solution of metal particles to further concentrate them. Armstrong teaches that the titanium metal should be maintained below the sintering temperature and that the use of sufficient sodium metal should be used to control the temperature of the metal product (Col. 5, lines 19-34). Throughout Armstrong, sodium metal is used as a heat exchanger fluid and a means to shuttle reactants and products. Reintroduction of decanted sodium is an obvious step in view of the use of sodium as a washing fluid to carry reactants and products in addition to controlling the temperature of the product as a heat exchange medium (Col. 5, line 66 to Col. 6, line 5). Furthermore Armstrong teaches that the reducing agent, sodium, should be recycled (Col. 2, lines 48-54). Keller provides the well-known process of decantation to drain off the excess sodium metal (inherently at a temperature greater than the melt temperature is it is liquid and the salt too is mentioned as being able to be drained off, thus both are liquid) to concentrate titanium product with some residual salt. Lastly, Armstrong teaches a final filtration step where the titanium particles are separated from the remaining original constituents. Motivation to combine the two references comes from the work of both references in addressing

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the need to separate unwanted constituents from a slurry after formation of titanium metal.

Regarding claim 16, Keller taught decantation of molten sodium from a sodium-salt-titanium slurry. Such a slurry will inherently separate according to density with the denser titanium particles sitting on the bottom ( $4.55 \text{ g/cm}^3$ ), molten sodium chloride ( $2.16 \text{ g/cm}^3$ ) above it, and then molten sodium metal on top ( $0.97 \text{ g/cm}^3$ ). Keller further taught that the salt (sodium chloride) may be drained off from the slurry as well (Col. 5, lines 4-6). Armstrong teaches filtering of a salt-titanium mixture to yield titanium particles (Col. 7, lines 16-30). This mixture can then be cooled in the manner suggested by Keller and then water washed.

Regarding claim 2, a gel will inherently be formed following the removal of liquid metal as the density and viscosity will increase with the removal of liquid after carrying out the process of claim 1.

Regarding claims 6 and 23, Both Armstrong and Keller teach the use of alkali and alkaline earth metals as liquid metals.

Regarding claim 7, Armstrong taught that the titanium product should be kept from sintering, and as the molten sodium - molten sodium chloride mixture is in contact with the titanium product, both should be kept below about  $1000^\circ\text{C}$  (Col. 4, lines 9-11; Col. 5, lines 18-33).

Regarding claims 8, 18, 19, 20, 24 Armstrong teaches that sodium metal can be used with a liquid alkaline metal such as calcium to form a mixture. Upon reaction with a titanium tetrachloride reagent, a  $\text{NaCl} - \text{CaCl}_2$  mixture would inherently form as both

metals have a well-known higher affinity for chlorine compared to titanium. Keller also teaches that a mixed salt system of sodium and calcium, magnesium, etc. should be employed to avoid operating at higher temperatures (Col. 6, line 70 to Col. 7, line 13). A eutectic system mixture would be an obvious variation in concentrations of the two salts based on the knowledge of one of ordinary skill in the art as the meaning of a eutectic in having the lowest possible melting point and the general commercial trend to minimize heating in metallurgical processing to minimize operating costs.

Regarding claims 9, 10, 14, and 15, both Armstrong and Keller teach the separation of titanium particles. Furthermore both references teach that titanium alloys can be made (Armstrong: Col. 7, lines 47-51 and Keller: Col. 7, lines 25-35). Ti-6 Al- 4V is the one of the most popular and widely use titanium alloys and one of ordinary skill would clearly see the economic and time-saving advantages of forming alloy particle product of this composition for sale. Furthermore, both Armstrong and Keller teach using sodium metal as the reducing agent to form titanium particles. This sodium metal is well-known to form sodium chloride after reducing the titanium tetrachloride reagent.

Regarding claims 11-13 and 21-22, Keller teaches the decantation of excess molten salt (NaCl) by-product from a titanium-salt-sodium slurry. Being molten, this NaCl liquid with inherently be at a temperature of greater than about 800 °C, which is approximately its melting point. In using a eutectic NaCl-CaCl<sub>2</sub> mixture, which was taught to be obvious in the 103 rejections above, the melting temperature is around 600 °C as taught in the specification (top of p. 5).



Regarding 17, Armstrong teaches a liquid salt of NaCl and salt particulates of NaCl. Similarly, Keller teaches that "from the standpoint of simplicity of operation and ease of control, it is preferred, however, that the salt be the chloride of the reducing agent" (Col. 7, lines 70-73).

Regarding 25, given decantation as a well-known separation process, using suction to remove the liquid metal without removing the metal particulates in the process would be clearly obvious to one of ordinary skill in the art. Allowing metal particulates to escape during the draining of the liquid metal would be completely counterproductive in concentrating the metal particulates and wasteful in that the end product is being moved into another area of the processing system away from the filtration system.

### ***Conclusion***

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: The following references deal with producing titanium particles and/or separating metal particles from a slurry.

**Mansan** (US 2,816,828)

**Burr** (US 2,835,567)

**Winter** (US 2,890,112)

**Grantham** (US 4,379,718)

**Kametani** (US 5,032,176)

**White** (US 5,259,862)

**DeYoung** (US 5,427,602)

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**Celik** (US 5,914,440)

**Alt**, Christian Alt, "Solid-Liquid Separation, Introduction" in Ullmann's Encyclopedia of Industrial Chemistry, Wiley-VCH Verlag GmbH and Co., Online June 15, 2000.

**1. Claims 1-25 are rejected****2. No claims are allowed**

The rejections above rely on the references for all the teachings expressed in the text of the references and/or one of ordinary skill in the metallurgical art would have reasonably understood or implied from the texts of the references. To emphasize certain aspects of the prior art, only specific portions of the texts have been pointed out. Each reference as a whole should be reviewed in responding to the rejection, since other sections of the same reference and/or various combinations of the cited references may be relied on in future rejections in view of amendments.

All recited limitations in the instant claims have been met by the rejections as set forth above. Applicant is reminded that when amendment and/or revision is required, applicant should therefore specifically point out the support for any amendments made to the disclosure. See 37 C.F.R. § 1.121; 37 C.F.R. Part §41.37 (c)(1)(v); MPEP §714.02; and MPEP §2411.01(B).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark L. Shevin whose telephone number is (571) 270-3588. The examiner can normally be reached on Monday - Thursday, 8:30 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vickie Kim can be reached on (571) 272-0579. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

**MS**December 19<sup>th</sup>, 2007

/Vickie Kim/

Supervisory Patent Examiner, Art Unit 4116

